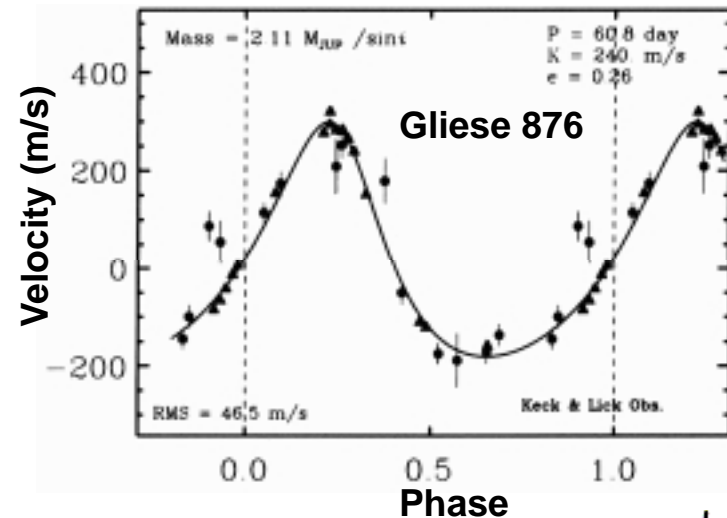


EOS / Giant planets

Giant planets are generating great interest, with the discovery of extrasolar planetary systems



Marcy *et al.*, *Ap. J.*
505, L147 (1998)



Gl 229: brown dwarf

$M \sim 0.04 M_{\text{Sun}}$

$d = 6 \text{ pc}$

Gl 876: planet

$M = 2.1 M_J$

$d = 4.72 \text{ pc}$

ν And b,c,d: planets

$M = 0.7, 2.1, 4.6 M_J$

$d = 16.5 \text{ pc}$

τ Boo b: planet

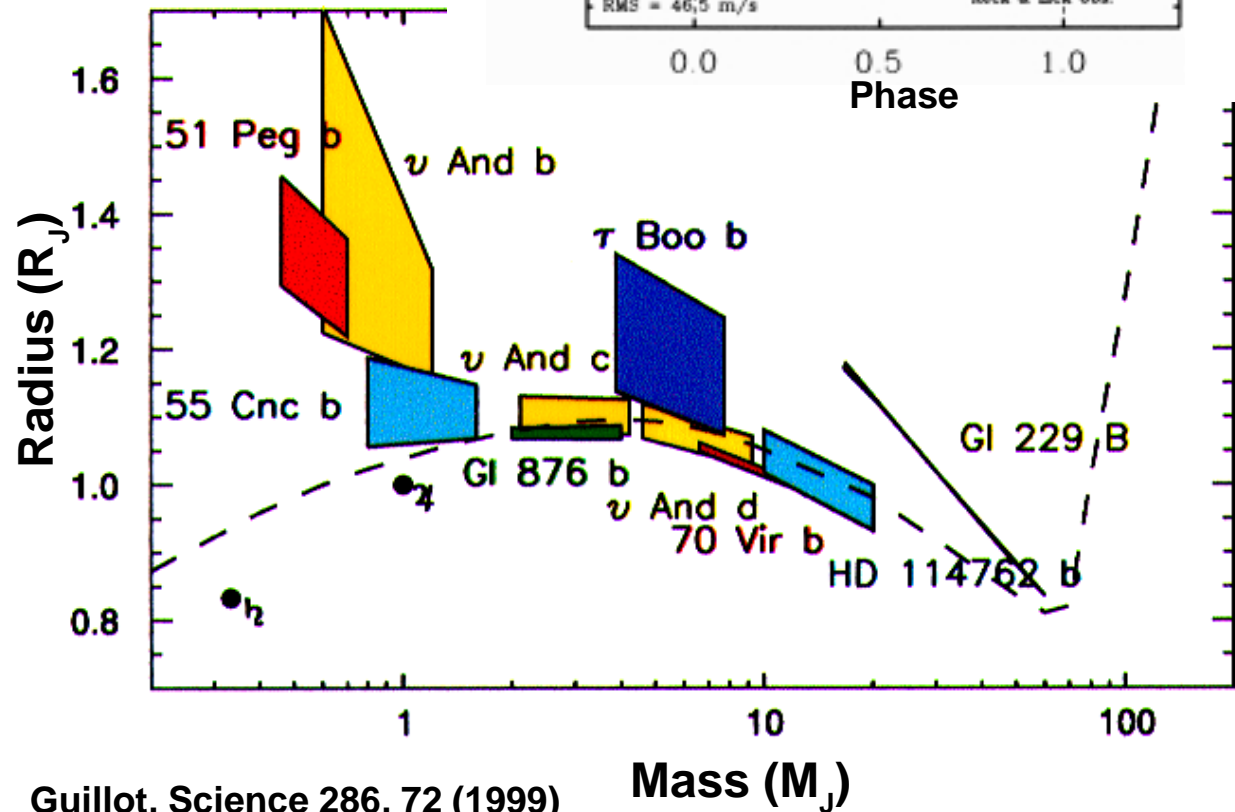
$M = 5 M_J$

$d = 15 \text{ pc}$

51 Peg b: planet

$M = 0.9 M_J$

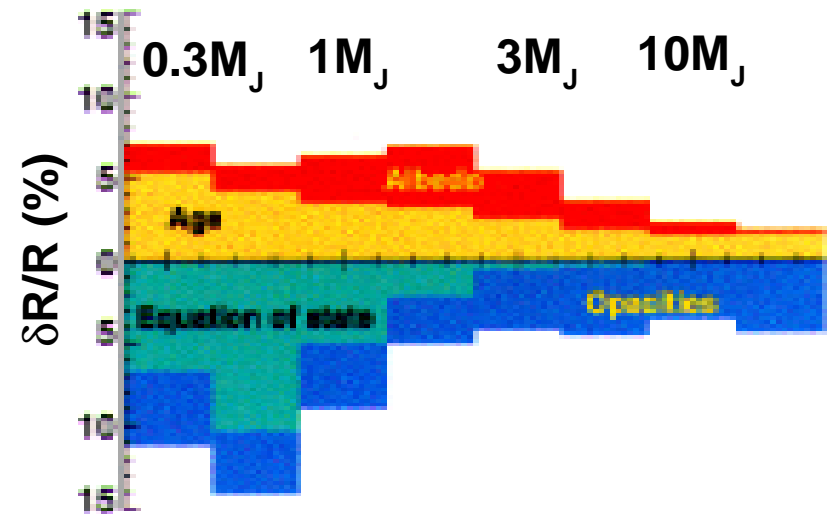
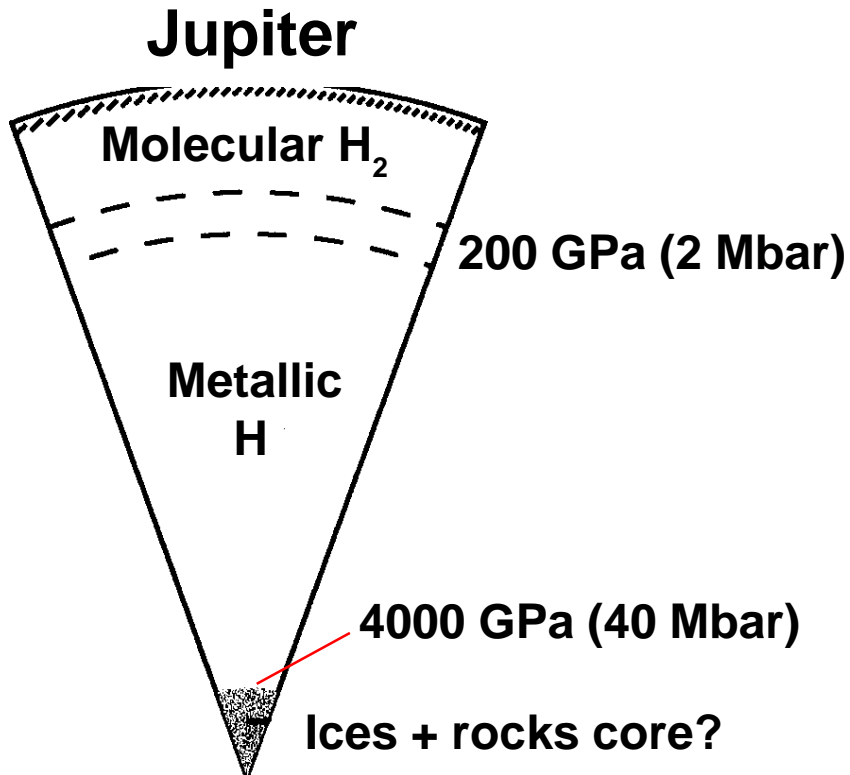
$d = 14.7 \text{ pc}$



Guillot, *Science* 286, 72 (1999)

Mass (M_J)

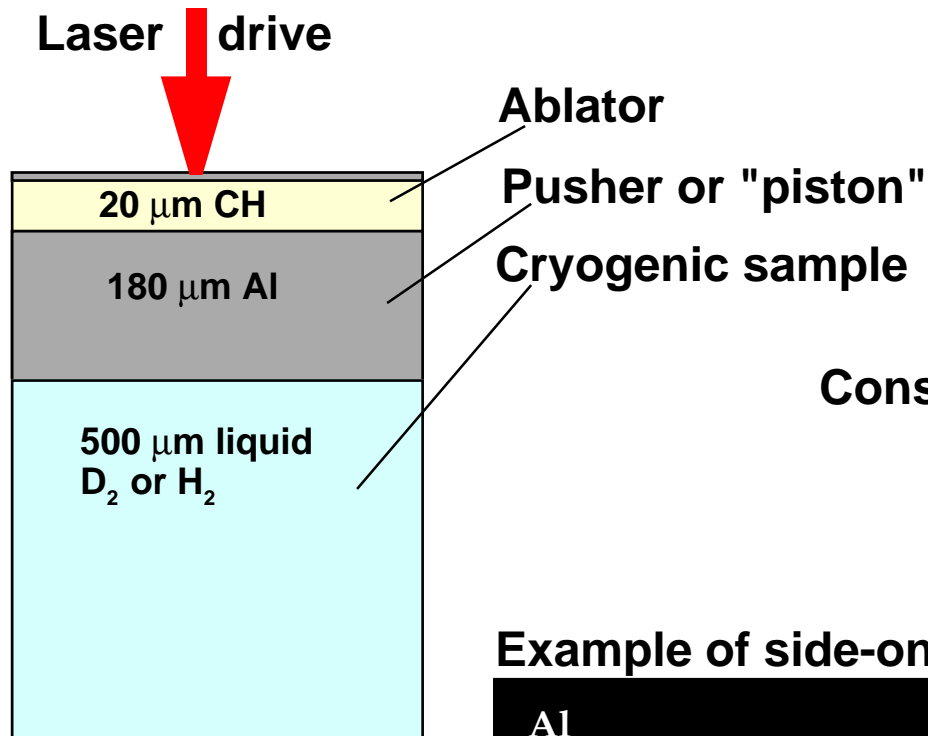
The internal structure of giant planets is very sensitive to the EOS of hydrogen and helium



Guillot, Science 286, 72 (1999),
and Icarus 130, 534 (1997)

- Some EOS models even suggest there is no core in Jupiter, which is counter to a standard planetary evolution model

The EOS of D₂ was mapped out by measuring compression as a fnc. of applied pressure

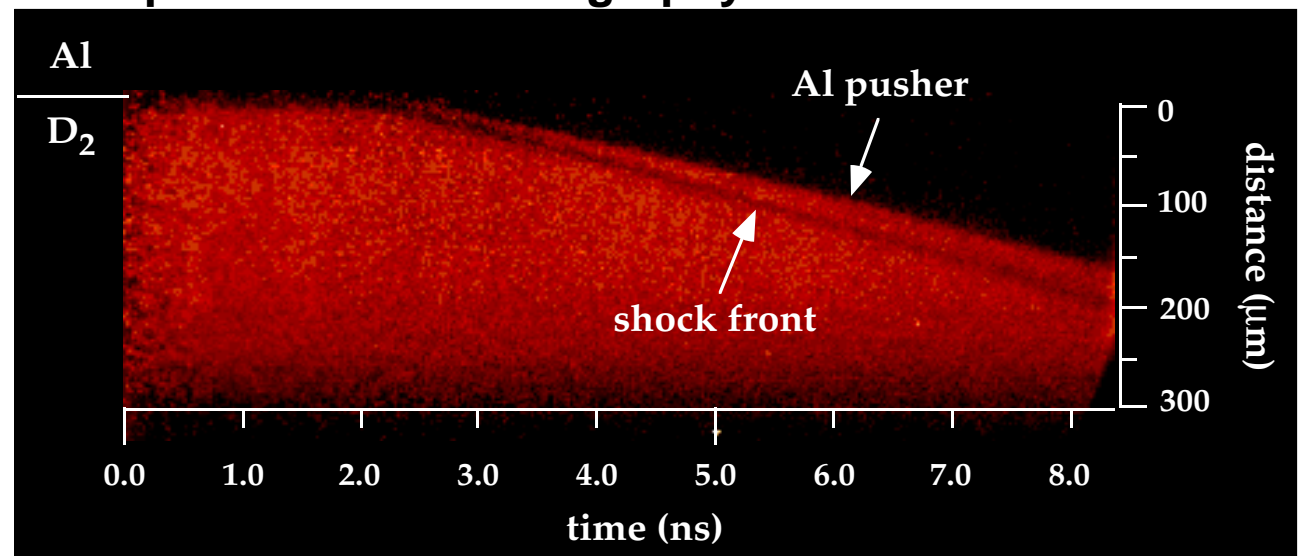


- Msmt. techniques include:
 - Side-on radiography
 - Shock reflectivity
 - Color temperature

Cons. of momentum: $P - P_o = \rho_o U_s U_p$

Cons. of mass: $\rho = \frac{\rho_o}{\left(1 - \frac{U_p}{U_s}\right)}$

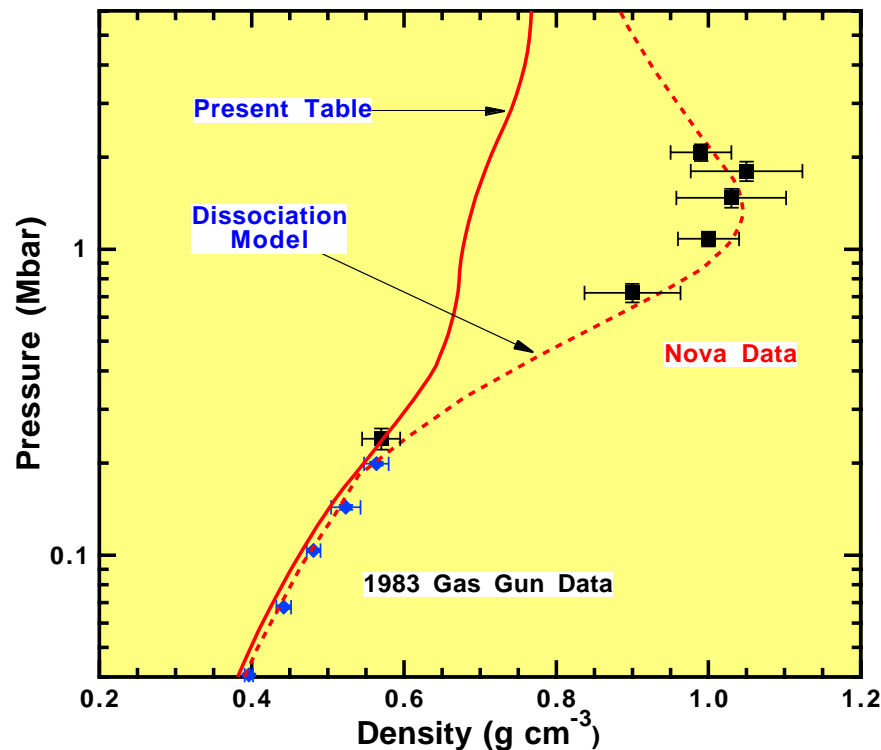
Example of side-on radiography



Collins *et al.*,
Science **281**, 1178 (1998)

Mostovych *et al.*,
G01.16, this conference

EOS of D_2 has been measured at $P > 1$ Mbar on Nova and Nike; softening due to molecular dissociation observed



- Similar high-pressure effects occur at the cores of the giant planets
- Models of the core of Jupiter are being updated to account for these data

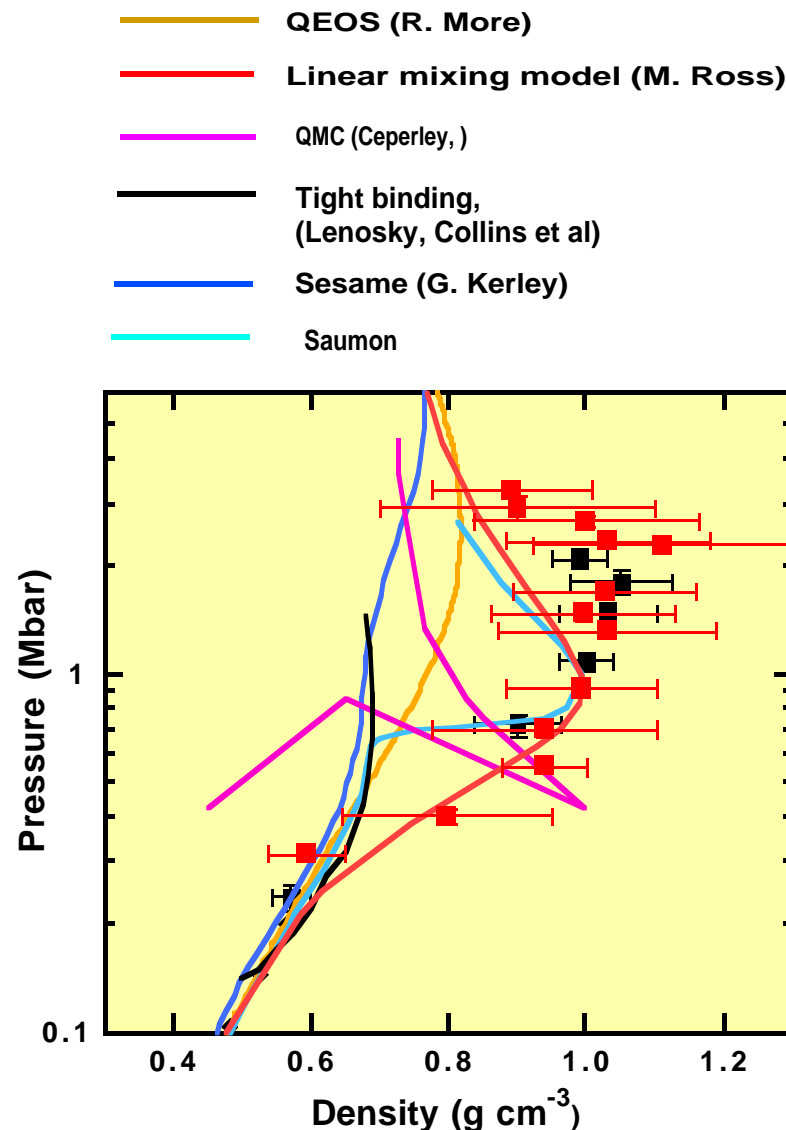
DaSilva *et al.*, Phys. Rev. Lett. **78**, 483 (1997);

Cauble *et al.*, Phys. Rev. Lett. **80**, 1248 (1998);

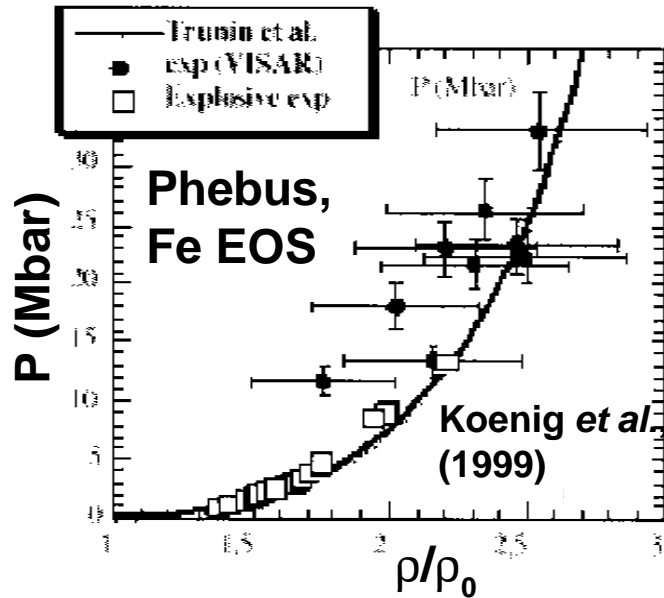
Collins *et al.*, Science **281**, 1178 (1998).

Mostovych *et al.*, paper GO1.16, this conf.

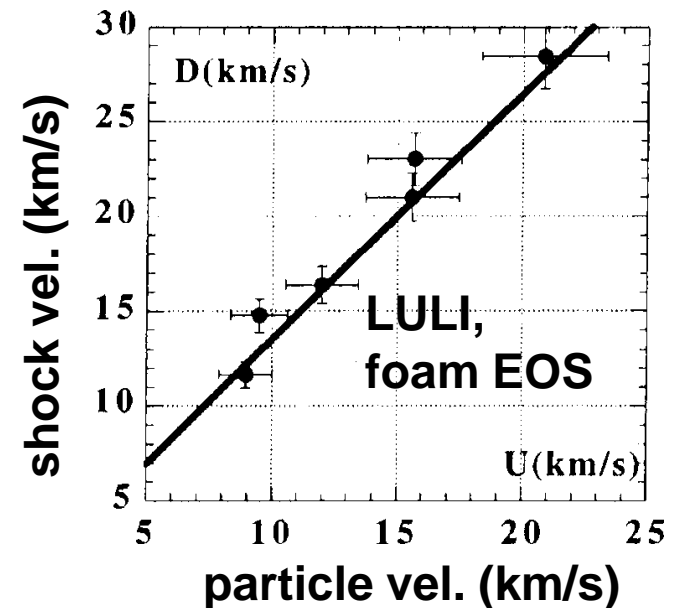
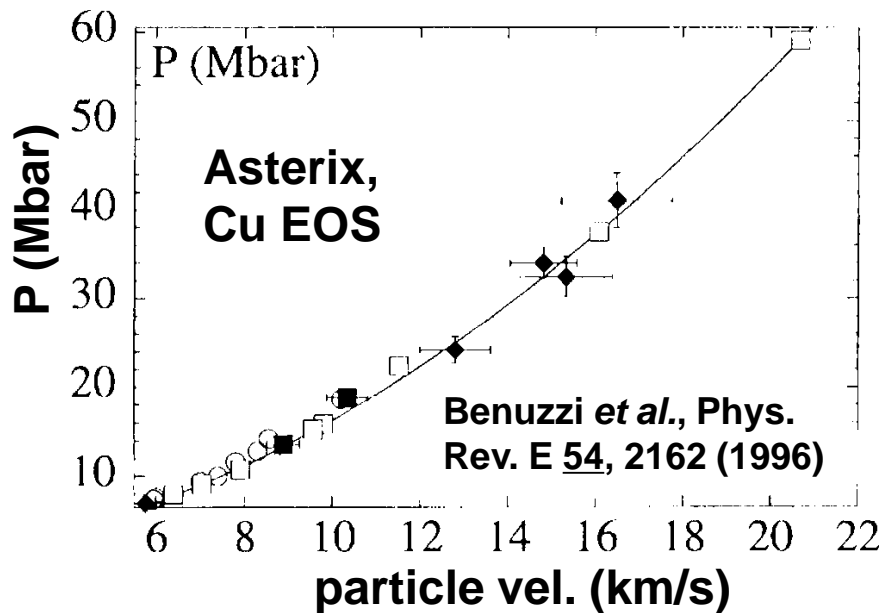
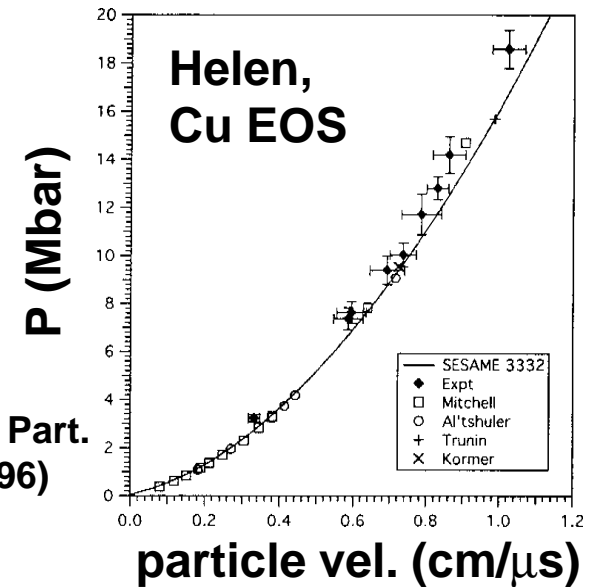
D2_EOS.pm6.5b



High pressure EOS experiments have been done on the Phebus, Asterix, LULI, and Helen lasers



Evans et al., Laser Part. Beams 14, 113 (1996)



Koenig et al., Phys. Plasmas 6, 3296 (1999)